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MARYLAND FISHERIES

PUBLISHED BY CONSERVATION DEPARTMENT OF MARYLAND

No. 26 BALTIMORE, MARYLAND January, 1934

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AN ACT SETTING ASIDE CERTAIN AREAS FOR CLAMMING

SINCE the August storm, which caused the opening of the inlet connecting the ocean with Sinepuxent Bay, the Conservation Department has received a number of requests from residents of Worcester County, who are engaged in the clamming business, asking that certain bottoms be set aside for this purpose. It was accordingly deemed advisable to bring this matter before the Legislature at its recent special session, and after conferring with Senator Milton Veasy of Worcester County, the following bill was drafted, introduced and passed by the General Assembly.

The bill is being given in full, excluding the title, for the information of the oyster planters and clammers of Worcester County:

SECTION 1. *Be it enacted by the General Assembly of Maryland*, That Section 154B of Article 72 of the Annotated Code of Maryland, title "Oysters," sub-title "Oyster Culture," as same was enacted by Chapter 300 of the Acts of 1933, be and the same is hereby repealed and re-enacted with amendments to read as follows:

Section 154B. The waters of Worcester County, except those exempted by Section 125, and such waters as are or may be designated as clamming grounds, provided for in Section 154BB, are hereby declared to be open for oyster culture, according to the provisions of this sub-title and as herein provided.

Any resident of Maryland who may desire to plant or cultivate oysters on said area may apply to the Conservation Department for a lease, not exceeding fifty acres to any one person.

At the time of filing the application the applicant shall stake out the ground applied for and designate same by four suitable stakes or markers, one of which shall be placed on each corner of said lot, and shall plainly mark his name on the two outer stakes. Said stakes when properly placed shall designate the lot applied for and give the applicant prior rights to said ground until the surveyor of the department shall have an opportunity to survey same in order to get the proper boundaries. After said ground has been so surveyed, the stakes or buoys must be kept up, as is required in the case of other leased ground in the State.

Whenever the Conservation Commissioner shall consider that the Ocean City Inlet is sufficiently advanced to warrant the leasing of oyster bottoms, he shall give notice, by publication in a newspaper of general circulation in Worcester County, that on a day to be named in said notice, he shall receive applications for lease; and no application shall be acted upon by the Conservation Commissioner until after the giving of said notice as herein provided.

All applications shall be given priority in the order in which they are received, except for a period of thirty days after the effective date named in said notice priority rights shall extend to any bona fide owner or occupant of a planted area in any of these waters.

After said thirty days have elapsed, any resident of Worcester County shall have prior right over all other applicants for a period of thirty days.

No assignment or transfer of any interest acquired by this sub-title shall be valid for any purpose if made to a non-resident of this State, a corporation or joint stock company. If any such assignment is attempted to be made, or if any assignment of any interest created by this sub-title is attempted to be made, in such way that the assignee shall become the holder of more than fifty acres, all interest of the grantor or assignor, shall revert to the State as if no lease had ever been made.

SEC. 2. *And be it further enacted*, That a new section be added to Article 72 of the Annotated Code of Maryland, title "Oysters, " sub-title "Oyster Culture," to follow immediately after Section 154B, to be known as Section 154BB, and to read as follows:

SECTION 154BB. The following waters of Worcester County, subject to the provisions of this Section, are hereby designated as clamming grounds for Worcester County, viz:

All waters easterly of a line drawn as follows: Beginning at a point about 1,500 yards westerly of the western extremity of an unnamed island lying westerly of an island charted as Pope's Island, which point is on the Maryland-Virginia boundary line in the waters of Chincoteague Bay; thence running a northerly course to White Rock; thence running a northeasterly course to a point known as Whittington Point, thence running a northerly course to the southernmost point of the newly constructed channel from the Ocean City Inlet, which point is located about one mile northeasterly of Robins Marsh; thence running in a northeasterly direction by and with the said channel up to the inlet which connects the Atlantic Ocean and Sinepuxent Bay; and all waters in Sinepuxent, Isle of Wight and Assawoman Bays lying north of said inlet on the eastward or beach side of said bays, known as sand shoals.

The Conservation Department is hereby directed to file in its office in the City of Baltimore and in the office of the Clerk of the Circuit Court of Worcester County a chart showing the lines designated above as clamming grounds.

The Conservation Commissioner may at any time hereafter survey and examine any portion of the areas which are subject to lease and the clamming grounds for the purpose of relocating the lines designated above. If upon such survey, he shall find that conditions warrant a change of said lines, he shall publish an amended chart showing the lines thus re-established. Said amended chart shall be filed in the office of the Conservation Department in the City of Baltimore within ninety days thereafter and copies shall be filed with the Clerk of the Circuit Court of Worcester County, provided that such surveys shall not in any way affect leases of a part or all of the areas re-surveyed, actually issued and in force at the time of such survey, unless the respective lessees thereof shall voluntarily surrender their leases or shall have forfeited same by reason of non-payment of rentals; and provided further that before filing any amendments to the chart, he shall cause to be published in a paper of Worcester County for three successive weeks a notice of his intentions so to do and set a date in said notice when and where a public hearing will be held.

SEC. 3. *And be it further enacted,* That Section 154D of Article 72 of the Annotated Code of Maryland, title "Oysters," sub-title "Oyster Culture," as same was enacted by Chapter

432 of the Acts of 1931, be and the same is hereby repealed and re-enacted with amendments to read as follows:

Section 154D. A lessee is privileged to cultivate or remove oysters so planted on his leased area in any manner that he deems proper provided he has complied with the law providing for the licensing of boats or tongers in removing them for market or transplanting.

All the rights of a lessee provided for in Section 123 of this Article shall apply to a lessee holding ground under this sub-title with the further right to exclude all persons from crabbing, fishing with nets or clamming upon his leased area.

If any part of the rent reserved under such leases shall remain unpaid sixty days after same becomes due, such lease or leases may be, at the option of the Conservation Department declared void. In that event the land shall revert to the State and may be leased again in accordance with the provisions of this sub-title.

SEC. 4. *And be it further enacted,* That this Act is hereby declared to be an emergency law and necessary for the immediate preservation of the public health and safety, and being passed by a yea and nay vote, supported by three-fifths of all of the members elected to each House of the General Assembly, shall take effect from the date of its passage.

The Department's engineer has completed the charts of the area mentioned in the new act, and blue prints have been made and will be filed with the clerk of the Circuit Court of Worcester County. These blue prints may be inspected at the clerk's office, and will enable all interested persons to get full information on the areas in question, and if there are additional areas, especially near the boundary line, which should be included, the Conservation Commissioner will call a hearing at Snow Hill for this purpose.

PEST MOSQUITO CONTROL—A PROPOSED CIVIL WORKS PROJECT

A CONFERENCE was held in Baltimore on December 9 for the purpose of discussing the opportunity offered by the Civil Works Administration for the initiation of mosquito control work in Maryland. Dr. T. B. Symons, director of the Extension Service of the University of Maryland, who called the meeting together, invited the heads of a number of State

agencies which might be involved in any way in the work, for the purpose, Dr. Symons explained, of avoiding any misunderstanding that might arise from time to time. He further stated that the people should be informed regarding the purpose of the project, and impressed with the fact that the work will not get rid of all mosquitoes, but that it is a constructive measure and the work must be done in a useful way. The heads of the State Department of Health, State Roads Commission, Conservation Department, State Forestry Department, as well as Mr. S. L. Thomsen, State supervisor of civil works projects; Dr. F. C. Bishopp, Bureau of Entomology, U. S. Department of Agriculture; Dr. E. N. Cory, State Entomologist; Dr. George S. Langford, specialist in insect control and Dr. Symons were present.

Mosquito work, Dr. Bishopp said, will be undertaken in 36 states and in view of this concerted drive against mosquitoes, he was of the opinion that there would be improvement in the mosquito situation throughout the country.

Dr. Cory stated that the mosquito control work to be done in Maryland will be confined, for the most part, to the salt marsh mosquitoes. He added, however, that in some instances a small amount of fresh water mosquito control work would be done. The fresh water work for the most part will be confined to clearing of trees in the upper reaches of the Pocomoke River to aid in the drainage of the tax ditches in Worcester and Wicomico Counties. At present, he stated that the initial work will be undertaken in Calvert County around Chesapeake City and in Worcester County around Ocean City. These towns will be used as training centers, and as fast as men of supervisory capacity are trained in these areas, additional projects will be undertaken in other areas. There have been allotted 2,048 men for the work. It was explained that the drainage work in the marsh areas was not drainage in the sense of drying up the marsh, but consisted of taking off the sheet water and permitting the tide to ebb and flow and in addition providing facilities for the killfish to move through the marsh so that they can feed upon mosquito larvæ. It was said that the water level is not materially changed. In view of this, Dr. Cory stated that it was his belief that there would be very little change in game conditions, and that the muskrat industry probably would not be materially affected. Mr. Earle, Conservation Commissioner, had expressed the fear that drainage of marshes would have a deleterious effect upon muskrats and certain species of wild fowl which breed therein.

It was emphasized at the conference that some provision should be made for supervising and follow-up work after the initial ditching had been done in various places, and it was thought the representatives present could serve as a tentative committee to study this question and consider cooperating in endeavoring to provide means of examining the work and formulating a future program.

PRELIMINARY REPORT BLUE CRAB INVESTIGATION, 1932-1933

By R. V. TRUITT.

INTRODUCTION

THE BLUE CRAB, *Callinectes sapidus*, affords a fishery in the United States worth in its entirety nearly two millions of dollars annually. Approximately eighty-five per cent of the wealth created by the use of this crustacean is realized in the Chesapeake Bay, the industry being shared by Virginia and Maryland alike. It is a surprising fact, however, that in spite of the vast yearly harvests and the hundreds upon hundreds of men employed in the industry, full or part time, many important developments in the biology of the crab remain just about unstudied. Educational institutions in the two states most greatly concerned have made excellent studies of most of the biological forms of economic interest within their territorial limits, but little has been done with this outstanding commercial species, this in spite of the fact that it is extraordinarily interesting from ecological, embryological and other approaches. Brooks of Johns Hopkins, in the eighties, followed by Hay and then by Churchill, U. S. Bureau of Fisheries, the latter about the period of the Great War, made inquiries into certain aspects of the biology of the crab. The work of none was complete though admirable as far as it was pursued. In addition, the Bureau of Fisheries later developed a tagging scheme that held considerable promise in crab studies, but the work was not completed.

The crab industry during the past fifteen years has had wide fluctuations in meat production. During 1925 it was reduced to approximately one-fifth of its more normal output. A check-up on the practices in the industry, made by the U. S. Bureau of Fisheries, showed that in both states operations were being carried on that were highly destructive to the fishery. The

conservation agencies concerned moved swiftly to correct the bad practices, such as floating green crabs, capture of egg-bearing crabs, marketing crabs that were under legal sizes, etc., and improvement in the industry followed. The period of the life cycle of the crab is short, two years, with the result that changes in conservation policies are soon reflected in terms of production, whether for good or bad.

As indicated, several gaps appear in the story of the life history of the blue crab:

(1) The number of times this form molts (sheds) is not known;

(2) The length of time required for the zoea or the megalops, larval crab periods, is not known:

(3) Only very limited studies have been made on the migratory habits of the species;

(4) Winter activities of the crabs have not been studied in a formal way;

(5) The distribution of the larval forms, whether vertical or horizontal, has not been established, except in such general terms as "at the mouth of the bay" or "in the lower bay";

(6) It has not been established in a thorough-going way whether or not crabs spawn more than once; and

(7) The fate of the crab after it has become exhausted, sexually, is not known.

Those directly concerned in the industry have not greatly encouraged scientific study of the crab. Superstition, hearsay, and faulty observations have been accepted, in the main, without question. The interest in each of the states involved has been largely concerned with "getting its share" or "keeping the industry from being monopolized by the other state." Such attitudes have been reflected from time to time into the action of the conservation authorities involved. Also, they have, in the past, incited ill feeling and even open hostility between the crabbers of the two commonwealths. During the past year the crab situation has been attacked in a more enlightened manner. Efforts at fact-finding have been made. The Experimental Station of the University of Maryland appropriated a sum of money to initiate a study of the biology of the blue crab. This was followed by a small grant from the Virginia Commission of Fisheries and the Maryland Conservation Department. The sum of $600 from all sources has

been made available over a period of eighteen months to support the inquiries. In addition, the Virginia Commissioner has placed at the disposal of those attacking the problem certain boats without which little worthwhile progress could have been made. Noteworthy in this connection was the assignment of the State Steamer *Maury* for use in rougher waters near the Capes and on the ocean just outside of the Capes.

SEASONAL DISTRIBUTION OF MALE AND FEMALE CRABS

Several investigators have held that there is a marked migration of blue crabs. Based upon catches of the crabbers, it has been concluded rather generally that mature females migrate to the lower bay region, very near the Capes, and hibernate. Two opinions exist as to the source of these migrating females: (1) The crabs move from the upper bay regions. Scientists have held to this view, while in the late years the men of the industry in Maryland and the upper tidewaters of Virginia have come to this conclusion: (2) The crabs come to the region of the Capes after having lived in the ocean. This opinion is held by most of the crab dredgers in Virginia and by several of the dealers, among them men of substantial leadership. In order that the facts concerning migration might be definitely established, the problem is being attacked, as follows:

A—Samples of crabs are being taken fortnightly, more often when possible, from four widely separated sections of Maryland's tidewater.

B—Samples of crabs are taken from the Virginia waters fortnightly, as far as practicable.

C—Trips are being made outside the Capes where, by means of heavy and efficient trawling gears, the ocean bottoms are dragged for crabs. Trawling has been done, year around, from below Cape Hatteras, North Carolina, to Absecon, New Jersey, and offshore some thirty odd miles.

Without attempting in this report to review the data gathered, it might be pointed out that there is very strong indication that adult female crabs migrate from the upper bay and river regions. Crabs do not live in great numbers far out in the ocean. Adult crabs were not found farther than fourteen miles offshore and only rarely at this distance. Although hundreds of drags, covering many square miles of bottom, were made farther offshore, in depths ranging from forty to fifty fathoms, not a single crab was taken. Beds of

crabs, comparable to those found just inside of inlets and bays have not been located in the ocean, except at or near the mouth of some tributary. Crabs from such beds were, in almost all cases, senile females. Many of them were found to be exhausted and about dead, apparently having completed their life cycle. Such beds, estimated in cases to hold five or six hundred barrels of crabs, were found not more than three miles offshore and not more than five or six miles from an inlet. Farther up or down the coast from an inlet only very occasionally was a crab found. "Inlet" here should be defined as an opening to inland waters, such as the mouth of the Chesapeake Bay, Chincoteague Bay, etc.

Males do not migrate in the sense used here. They do move from the shallower areas into deeper ones for the purpose of overwintering. Rarely are crabs taken from Chesapeake waters in less than fifteen foot depth during the winter. In twenty to thirty-foot waters virile crabs, mostly juveniles, both male and female, abound in the Maryland region, while the senile males apparently seek out deeper waters still. "Jimmy" crabs, oldest males known, bed for winter almost entirely in channel waters, "holes" and "pots." Oyster beds or rocks are favorite wintering grounds for the more active crabs.

Drawing conclusions for distribution over a long period of time is not entirely justifiable from the data accrued. Nevertheless, certain seasonal tendencies are noted in connection with the distribution of crabs in the Chesapeake. In Virginia, below the York River, among the adults, females predominate throughout the year, averaging upward of 85% of the crabs captured. Above the York, there is a sharp decline until the region of the Potomac (Smith's Point), where the sexes are about equally represented except for the fall season, when 60, 65 or even more females may appear to the hundred crabs caught. During winter, dredging in Maryland shows a distinct excess of males among the mature crabs, while the sex ratio in immature forms is about 50-50 to the hundred. In Maryland this ratio holds the year around for immature crabs. However, during a period of some six or eight weeks in the fall—varying from late September until mid-November —there is an excess of adult females in the mid-bay region from Solomons Island-Hoopers Island southward. This fall excess of females is variable from day to day, and highly variable from year to year. On September 22, 1931, the run of crabs at Solomons Island was 81 females and 19 males

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MARYLAND FISHERIES

PUBLISHED BIMONTHLY BY CONSERVATION DEPARTMENT,
SWEPSON EARLE, Commissioner.

No. 26 BALTIMORE, MARYLAND January, 1934

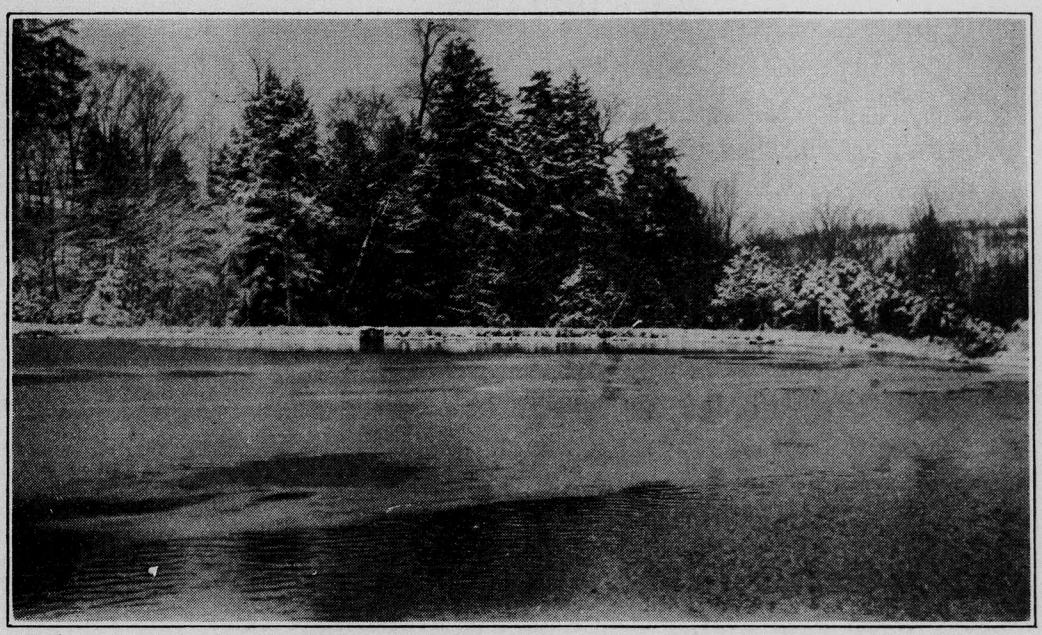
OYSTER PRODUCTION SHOWS GAIN

REGARDLESS of the fact that the oyster season started in September with a light demand and October showed a fall-off in production under the previous year, the Department is glad to be able to report that at the close of the year, December 31, there was an increase of 20% over the same period in 1932. The activity in the oyster market started with the cold spell of two weeks before Thanksgiving, when the demand became very active, in fact, many of the oyster houses were unable to supply their orders. Because of the lateness of Thanksgiving, there was an active demand all during the month of December, which increased as Christmas drew near.

A check-up on the inspection tax on oysters revealed that credit for the increase in the oyster production must go to the county shucking houses, as Baltimore City showed a fall-off in oysters shucked at this port under the year 1932.

The closing of certain oyster bars during the early part of the season, which held back a supply of good oysters for Thanksgiving trade, not only helped the production, but also gave the oystermen better returns for their labors. A striking example was Tolley's Bar, off the mouth of the Severn River, where from 100 to 115 boats were engaged daily for 10 to 15 days removing about 3000 bushels a day. The oysters from this bar sold for more than $1,200.00 a day and gave the packing houses, not only of Anne Arundel County, but other sections, a much needed supply.

The Potomac River oysters, due to their size and quality, brought a very high price, most of which were sold to the Crisfield packers. Two oyster bars in Chester River, Buoy Rock on the northerly side of the channel, and Piney Point on the easterly side, have so many small oysters that a petition has been sent to the Conservation Department to have these two bars closed. An investigation that was made warrants the carrying out of this request, and the Department is arranging now to close these bars until next fall, in order to protect the young growth and at the same time to prevent these oysters from being sacrificed at a low price.



TROUT LAKE AT BEAR CREEK HATCHERY

THE CREEL LIMIT—A DAY'S FISHING IN SEVERN RUN—APRIL, 1933

MARYLAND FISHERIES

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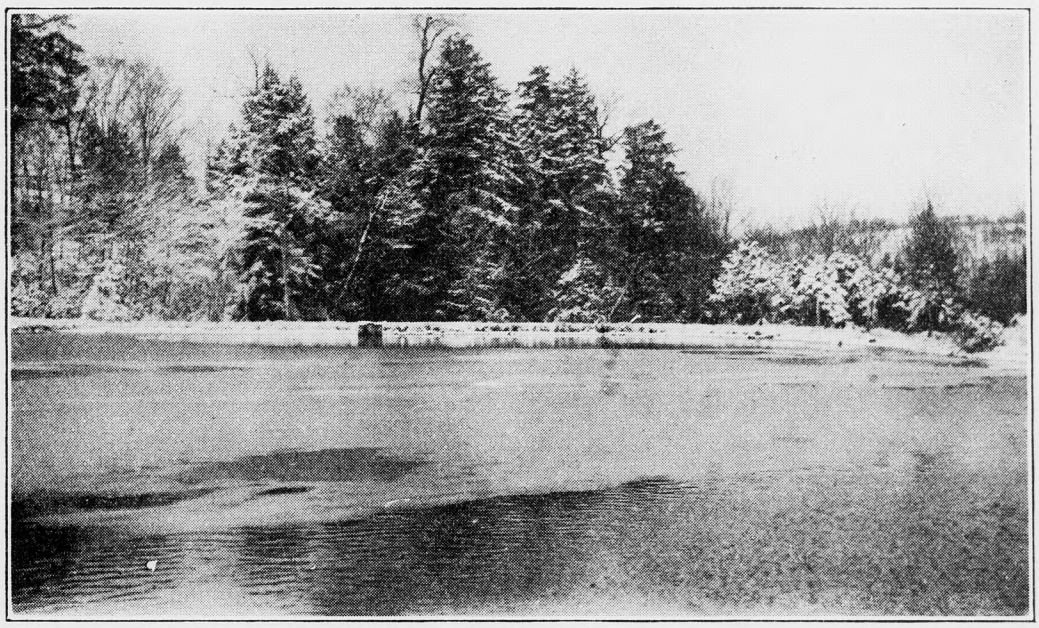

TROUT LAKE AT BEAR CREEK HATCHERY

THE CREEL LIMIT—A DAY'S FISHING IN SEVERN RUN—APRIL, 1933

PRELIMINARY REPORT BLUE CRAB INVESTIGATION, 1932-1933

(*Continued from Page 9*)

to the hundred. Approximately the same ratio held for the Crisfield catch, that date. Two weeks later the ratio of females to males was 61 to 39. One year later, figures taken on the same dates were just about turned around. September 22, 1932, showed 60 females and 30 males, while October 6 produced 77 females to 23 males. However, the adult female population farther up the bay was decreasing at this time while the quantity of crabs in Virginia waters was on the increase, the females being far in excess clear to the Capes. By December, adult males are present in excess of adult females from the head of the bay down to Pocomoke Sound and across to the Potomac River. At these points the female population grows larger than the male population and continues to increase until the ocean is reached. Just inside the Capes very few males are found, usually less than ten to the hundred crabs caught. The crabs found on the ocean floor proper are almost entirely females, only an occasional male being taken.

It is felt that by taking biweekly or even monthly samples from representative stations, all the way from the head of the Chesapeake to the ocean, and to the end of the offshore range, the movements of crabs in the Chesapeake may be completely established. This work has passed through two summers and one winter with considerable promise of success. It is hoped that more intensive work along this line may be done during the next twelve months.

SPAWNING AREAS

It is quite generally known that crabs in the Chesapeake spawn during the summer months, and that early June might be termed the peak of the spawning season. These activities begin in late April and extend over until early October, although an occasional "sponge crab" is taken in March and in December. Heavy spawning occurs from late May until late August. Virtually no spawning takes place above Wolf Trap, a region in the lower bay, although with lessened frequency sponge crabs are taken from more northerly points. Our records include sponge crabs from the Choptank River, Chester River, Rock Hall, Solomons, Tolly's Bar (Annapolis), in the brackish

water above Tolchester, Md. However, it is in the region of the Capes that intensive spawning takes place. Crabs ready to spawn crowd the area within 20 miles of the ocean and many sponge crabs pass out into the sea. In fact, the crab taken farthest offshore during the summer season was an egg-bearing female. The greatest concentration of egg-bearing crabs takes place between Cape Henry and Ocean View, while a very heavy concentration of such crabs is common just northward of Fisherman's Island and Cape Charles. Neither dredges nor trout lines gave indication of marked abundance of egg-bearing crabs in the ocean, this being conclusive for distances greater than five miles off shore.

DISTRIBUTION OF LARVAL CRABS

The difference in the dispersal area of first-stage (*zoea*) crabs and the spawning areas is to be found in the ocean. Most of the egg-bearing crabs remain in the bay near the Capes. Heavy concentrations of zoea (taken in plankton net water samples) are found on the same areas, but, in addition, zoea are about equally concentrated in the ocean near the Capes. In fact, in the channel regions between the two capes the heaviest concentration of zoea are found, while the numbers seem to diminish gradually both upbay and seaward. During the course of this work, zoea were taken farther offshore than were adult crabs, some eighteen miles. Zoea are delicate, microscopic organisms, fairly active but incapable of migrating great distances. It seems a fair assumption to hold that their dispersal is determined largely by the tides. It is hoped that more conclusive studies will be made in order that the seaward movement of zoea may be better understood.

Immature crabs, after growing and molting, pass into a second stage, the megalops. This form is more crab-like in appearance than is the zoea, though to a casual observer it would seem more like a tick than a blue crab. Zoea can swim only, while the megalops can crawl as well as swim. In the course of the present work, very little information has been gathered about the distribution or whereabouts of this form. A few megalops were taken from the water samples at the mouth of the bay and just inside of the Capes. In addition, a few were taken in the breakers, just inside of the Capes on both sides of the bay. The greatest number of megalops taken in a one-minute towing of a meter net was 22. In this same haul about 16,000 zoea were taken. Samples taken on the bottom of the bay showed megalops only twice, a total of four. Apparently one or the other of two explanations will account

for the poor success in taking megalops: (1) Apparatus used was not properly designed for the work; or (2) the areas upon which this immature form thrives were not located. Since zoea are about evenly dispersed in the ocean and bay, and since the early crab (post-megalops stage) first puts in its appearance just above the zoea dispersal zone, there is indication that the apparatus used was inadequate. It is hoped that this phase of the crab work may be emphasized at a later date.

JUVENILE CRABS

As indicated above, the earliest stage of the juvenile crab (post-megalops) are taken in the bay. Some of these appear in the early fall though they are more commonly seen in the spring. Since crabs have not been reared under observation from eggs to adults, the growth periods, stages of development and molting activities are not known except by inference. During late October and November, crabs of some two-eighths to three-eighths of an inch wide are taken in Virginia waters in the lower part of rivers and in the bay. During November, 1931, 1932 and 1933, such crabs were taken as far north as Solomons Island, Maryland. However, it is during late April and May that very small crabs appear in vast numbers in these waters. By mid-June three-eighths to one-half inch crabs are found all the way to the head of the bay. It is true, however, that the greatest number of these small crabs are found in the region between the Rappahannock and the Choptank, and especially in the Pocomoke and Tangier Sounds and tributaries. In this region are to be found the finest shedding and feeding grounds in the entire Chesapeake.

SENILITY

As previously indicated in this report, adult male crabs seek out very deep bay waters for overwintering. They do not school as is the tendency among the females. During what is assumed to be the third winter most of the males die. The younger males captured along with the senile ones during December or January are much more active and alert. During February and March, or even earlier, old males are frequently taken dead or "sanded"; that is, with gills largely debris filled. A very small percentage of these crabs survive the winter.

Both by dredging and trawling in the ocean, schools of crabs were located near the Capes repeatedly during the winter of 1932-1933. Some times a school was found to be of consider-

able proportions—estimates running from 50 to 600 barrels per school. Such schools are not fixed or bedded as is commonly supposed. One was followed in January and its movement checked for three days. It moved seaward about three-eighths of a mile from its first position. Another small bed, probably less than 75 barrels, located in March, moved toward the mouth of the bay. These crabs represent a unique study. When they were hauled aboard ship they gave off a decided stench. Most of these were obviously old, being barnacle and "moss" covered. Their gills usually are partially sanded. The crabs are weak. When cooked and picked, they yielded barely more than one-third the quantity of meat produced by crabs taken in the bay, especially those captured well within the Capes. Occasionally when crabbers are operating in the bay, they chance upon just such schools of crabs near the Capes. They immediately cease operations for the catch will not sell, the dealers being able to tell easily the condition of the crabs from their external appearances. These catches usually are made in late winter or early spring. During March, 1933, a bed of crabs of this type was located between Cape Henry and Virginia Beach. A ten-bushel dredge was hauled up full of them, running approximately 30% dead. The living crabs in the dredge were weak and decidedly exhausted. A 50-mile northeast gale, some ten days later, washed many barrels of female crabs, dead or dying, up on the beach. Not infrequently trips have been made to Cape Charles and Cape Henry to investigate such crab mortality. In every case, even when the material was in a highly putrid state, it was apparent that the trouble was due to senility, sanded gills, barnacles and other marks of time offering the evidence. Sufficient evidence has been gathered to establish rather clearly that spent female crab schools during their last winter, become weak and die.

MOLTING

Just how many times crabs molt in reaching maturity is not known. Different students give different numbers, ranging from 10 or 11 to 18. Efforts have been made, as a part of the present study, to rear crabs from eggs to maturity. While some progress has been made in that species of crabs have been bred through, laboratory facilities available, have not been adequate for the blue-crab work. As matters now stand larval blue crabs have been carried no further than the second molt. It is hoped that in the near future running salt water will be available in the laboratory, and with this development progress is expected with crab larval studies. Present indications are that crabs molt twenty-odd times.

SPAWNING HABITS

Time and lack of money with which to pay expenses have made it impossible to carry on adequate experimental work to determine whether or not crabs spawn more than once. It is commonly held that they produce only one sponge. This conclusion has been challenged repeatedly by crabbers and others interested. A study was initiated in the course of this work, by which it was hoped to determine, through microscopic studies of the ovaries, whether or not the schooling crabs in the ocean were entirely egg-exhausted or spent. It is hoped that this work may be carried further since barely more than an approach to the subject has been made to date. Ample material for this investigation is available, the need being that of cooperation from some educational institution having facilities for histological work of this kind. Such procedure may offer a more reliable attack than that of penning crabs under artificial conditions and noting results. However, the last named method of attack on the subject is to be attempted as a check on the work of others.

HIBERNATION

It is commonly held that crabs hibernate. Also, it is generally held that crabs bury in the mud during winter. During the course of the present work it has been possible to check up on these assumptions. Already in this report, the case of the activity of the school of senile female crabs has been set forth. Similar records were made for schools of mature females in the bay not sexually exhausted. In two "pots" near Poplar Island, Maryland, many mature male crabs spent the winter. One of these deep holes is sheltered from easterly storms and the other from northerly storms, the disturbances which are most violent during the winter. Checks made by means of deep-tooth dredges show that when one of these "pots" is exposed the crabs leave it. "Flat-bar" dredges may be used to capture crabs here in ordinary weather. During or after a storm deep-tooth dredges fail to catch them, though the bottom is penetrated to its hard surface.

On one occasion during March of 1933 a school of adult female crabs was located in the lower bay and its position noted. Three days later the entire school had moved approximately 500 yards inshore. Three days later still, a northeast storm having intervened, the school had disappeared, apparently having been broken up. The movement of this school of crabs was noted each day during the first three days under

observation by means of dredges Three other such winter schools were located, but weather or other adverse conditions made it impossible to follow them through, though in two of the cases the schools were lost, indicating crab movement.

These observations are to be checked again during the season of 1933-1934 for further data, which, it is hoped, will permit of drawing of conclusions.

ACKNOWLEDGMENTS

Mr. George F. Beaven, of the Pocomoke High School, has spent two summers, 1932 and 1933, on Virginia waters and on the ocean, taking water samples in an effort to determine the distribution of larval crabs. During much of this time Mr. Beaven used his private boat without charging for it. Dr. Martha W. Shackleford, Oklahoma College for Women, gave three weeks of her time cooperating with Mr. Beaven in sample collecting and determination. Mr. Richard Armstrong in a large measure made offshore ocean collecting possible in that he granted liberal use of the large, comfortable and seaworthy motor vessel, *Malola,* which is privately owned. With one exception, the entire travel, involving many thousands of miles, was done in private cars (Dr. Shackleford's, Mr. Beaven's and Dr. Truitt's), for the use of which only the gasoline bill was charged.

DISTRIBUTION OF GAME FISH FOR THE YEAR 1933

County and Name of Stream	*Species*	*Size*	*Number*
ANNE ARUNDEL COUNTY			
Severn River	Large-Mouth Bass	5-7	360
Fulton's Pond	Large-Mouth Bass	4	500
Mill Creek	Large-Mouth Bass	5-7	100
Kitten Run	Brook Trout	*	150
Severn Run	Brook Trout	*	3,360
Adams Branch	Brook Trout	*	150
Total			4,620
ALLEGANY COUNTY			
Potomac River	Small-Mouth Bass	4	1,178
Potomac River	Large-Mouth Bass	5	150
Total			1,328
BALTIMORE COUNTY			
Tributary of Piney Run	Brook Trout	*	120
Beaver Dam Branch	Brook Trout	*	60
Patapsco River	Brook Trout	*	60
Long Quarter Branch	Brook Trout	*	60
Owl Branch	Brook Trout	*	60
Deep Run	Brook Trout	*	100
Lime Kiln Run	Brook Trout	*	250

County and Name of Stream	*Species*	*Size*	*Number*
Pot Spring Branch	Brook Trout	*	250
White's Branch	Brook Trout	*	100
Jones Falls	Brook Trout	*	1,000
Patapsco River	Small-Mouth Bass	4	1,000
Red Run	Small-Mouth Bass	4	200
Lake Roland	Large-Mouth Bass	4	2,200
Patapsco River	Large-Mouth Bass	5-6	50
Seneca River	Large-Mouth Bass	5-6	200
Druid Ridge Cemetery Lake	Large-Mouth Bass	5-6	100
Total			5,810
CARROLL COUNTY			
Beaver Branch	Brook Trout	*	800
Big Pipe Creek	Small-Mouth Bass	*	700
Double Pipe Creek	Small-Mouth Bass	3	260
Patapsco River	Small-Mouth Bass	3	250
Total			2,010
CAROLINE COUNTY			
Beulah Pond	Crappie	3	8,000
Langrall's Pond	Crappie	3	10,000
Dean's Pond	Crappie	3	6,000
Total			24,000
CECIL COUNTY			
Perryville Reservoir	Brook Trout	*	200
Total			200
FREDERICK COUNTY			
Fishing Creek	Brook Trout	*	3,615
Big Hunting Creek	Brook Trout	*	2,470
Little Hunting Creek	Brook Trout	*	1,686
Turkey Run	Brook Trout	*	430
Little Owen's Creek	Brook Trout	*	370
Tuscarora	Brook Trout	*	610
Fishing Creek	Rainbow Trout	*	1,710
Little Hunting Creek	Rainbow Trout	*	230
Big Hunting Creek	Rainbow Trout	*	2,710
Turkey Run	Rainbow Trout	*	50
Monocacy River	Small-Mouth Bass	4	800
Tom's Creek	Small-Mouth Bass	4	800
Owen's Creek	Small-Mouth Bass	4	800
Total			16,281
GARRETT COUNTY			
Deep Creek Lake	Yellow Perch	*	1,120
Savage River	Brook Trout	*	700
Blue Lick	Brook Trout	*	300
Bear Creek	Brook Trout	*	3,720
Deep Creek Lake	Brook Trout	*	1,715
Deep Creek Lake	Brook Trout	4-7	7,100
Total			14,655
HARFORD COUNTY			
Evans Run	Brook Trout	*	150
Deer Creek	Small-Mouth Bass	3	2,000
Conowingo Lake	Crappie	2-3	140,000
Conowingo Lake	Large-Mouth Bass	1-1½	55,000
Conowingo Lake	Large-Mouth Bass	7-8	970
Conowingo Lake	Yellow Perch	*	740
Conowingo Lake	Yellow Perch	4	1,220
Total			200,080

County and Name of Stream	*Species*	*Size*	*Number*
HOWARD COUNTY			
Little Patuxent River	Brook Trout	*	400
East Branch Patuxent	Brook Trout	*	275
Sucker Branch	Brook Trout	*	75
East Branch Patuxent	Crappie	3	20,000
Buckey's Pond	Crappie	3	500
East Branch Patuxent	Large-Mouth Bass	5-7	200
Buckey's Pond	Large-Mouth Bass	5-7	100
Patapsco River	Large-Mouth Bass	4	1,200
Total			22,750
KENT COUNTY			
Higman Pond	Large-Mouth Bass	5-7	500
Clother's Pond	Large-Mouth Bass	5-7	500
Higman Pond	Crappie	2-3	10,000
Clother's Pond	Crappie	2-3	8,000
Total			19,000
MONTGOMERY COUNTY			
Little Patuxent River	Crappie	2-3	15,000
Seneca Creek	Crappie	2-3	9,500
Little Patuxent River	Large-Mouth Bass	5-7	570
Total			25,070
QUEEN ANNE'S COUNTY			
Unicorn Lake	Crappie	2-3	5,000
Unicorn Lake	Crappie	5-7	400
Total			5,400
TALBOT COUNTY			
Lake Land Lakes	Crappie	2-3	30,000
Lake Land Lakes	Large-Mouth Bass	5-7	1,200
Total			31,200
WASHINGTON COUNTY			
Little Tonoloway Creek	Rainbow Trout	*	740
Forney Young Run	Rainbow Trout	*	710
Marsh Run	Rainbow Trout	*	280
St. James Run	Rainbow Trout	*	1,015
Extine Run	Rainbow Trout	*	390
Trout Run	Rainbow Trout	*	650
Little Antietam	Rainbow Trout	*	500
Potomac River	Small-Mouth Bass	3-5	900
Conococheague	Large-Mouth Bass	4-8	150
Total			5,335
WORCESTER COUNTY			
Pocomoke River	Crappie	2-3	10,000
Big Mills Pond	Crappie	2-3	15,000
Pocomoke River	Large-Mouth Bass	4-8	1,800
Big Mills Pond	Large-Mouth Bass	4-8	2,000
Total			28,800

*Indicates adult fish.
Numbers indicate size of fish according to inches.